An in-depth look at scientific solutions to a real-world problem

Wildlife and Highway Management

Lesson 2: How Do We Solve the Problem of Wildlife on Our Roads?

LESSON OVERVIEW

Students use actual scientific data to evaluate the movement of elk. Using this information, they must determine where to build three wildlife bridges or underpasses along the highway as well as develop several cost-saving alternatives. They will write a formal report to present their findings.

SUGGESTED GRADE LEVELS

- 7 – 12

ENDURING UNDERSTANDINGS

- Accurate and reliable data need to be analyzed impartially to develop conclusions.
- Technology has improved data collection for scientists.

OBJECTIVE

Students will:

- Analyze tables and graphs to come to a conclusion.
- Write a report in which their conclusions are supported by facts.

ARIZONA DEPARTMENT OF EDUCATION STANDARDS

Grade	Science	Mathematics	Writing
7	S1-C3-01; S1-C3-05; S1-C4-02; S1-C4-03; S1-C4-05; S3-C1-03; S3-C2-01; S3-C2-02	S2-C1-03; S2-C1-04; S2-C1-05; S2-C1-07; S2-C1-08; S2-C1-09	S2-C1-01; S2-C1-03; S2-C1-04; S2-C2-03; S2-C2-05; S2-C3-02; S2-C3-04; S2-C4-01; S2-C4-03; S2-C5-02; S3-C2-01; S3-C2-03
8	S1-C3-01; S1-C3-05; S1-C4-01; S1-C4-02; S1-C4-03; S1-C4-05; S3-C2-01; S3-C2-02	S2-C1-03; S2-C1-07; S2-C1-08	
High School	S1-C1-01; S1-C4-01; S1-C4-02; S1-C4-03; S1-C4-04; S3-C1-01; S3-C1-03; S3-C1-04; S3-C2-02; S3-C2-03; S3-C2-05	S2-C1-02; S2-C1-08; S2-C1-09; S2-C1-11	S2-C1-03; S2-C1-05; S2-C2-03; S2-C2-05; S2-C3-02; S2-C3-03; S2-C4-01; S2-C4-02; S2-C4-03; S2-C5-03; S3-C2-01

Note: The full text of these standards can be found in Appendix A.

TIME FRAME

- Two to three days (45 minutes each day)

An in-depth look at scientific solutions to a real-world problem

MATERIALS

- *How Do We Stop Wildlife-Vehicle Collisions* worksheet (one per team)
- *Ecology* of *Elk* worksheet (one per team)
- *Elk Movement Research* worksheet (one per team)
- *Research Rubric* (one per team)
- Computers with Internet access (one per team) or copies of various Web sites for research

TEACHER PREPARATION

- Make copies of the *How Do We Stop Wildlife-Vehicle Collisions*, *Ecology of Elk*, and *Elk Movement Research* worksheets and the *Research Rubric* for each team. You might also want to make copies for each student.
- If computer access is not available, preview the Web sites and print out relevant information. You should find specific ways to prevent wildlife-vehicle collisions. Make copies of these for students to use in class.

SUGGESTED PROCEDURES

1. Divide the class into teams and hand out the worksheets.
2. Read the first worksheet, *How Do We Stop Wildlife-Vehicle Collisions*, as a class and review the map of proposed sites.
3. Inform the teams that the remaining worksheets present data on elk ecology and elk movements across the highway. They must analyze the data to determine where to build the bridges or underpasses. They will then use the computers or the printed material to research alternatives to bridges and underpasses and determine if any will work best in this situation. Each team (or each student if you prefer) will then write a research report that explains their conclusions.
4. Be sure to allow sufficient time. This portion of the assignment may take more than one day.
5. When the teams have completed their analyses, assign the research report.

ASSESSMENT

- Research report

EXTENSIONS

- Have students research the work done in Banff National Park along the Trans-Canada Highway and compare it to the plan for State Route 260 in Arizona.

Appendix A: Arizona Department of Education Standards – Full Text

Science Standards

Grade	Strand	Concept	Performance Objective
7	1	3 – Analysis and Conclusions	1 – Analyze data obtained in a scientific investigation to identify trends 5 – Formulate a conclusion based on data analysis
		4 – Communication	1 – Choose an appropriate graphic representation for collected data 2 – Display data collected from a controlled investigation 3 – Communicate the results of an investigation with appropriate use of qualitative and quantitative information 5 – Communicate the results and conclusion of the investigation
	3	1 – Changes in Environments	3 – Propose possible solutions to address the environmental risks in biological or geological systems
		2 – Science and Technology in Society	1 – Propose viable methods of responding to an identified need or problem 2 – Compare solutions to best address an identified need or problem
8	1	3 – Analysis and Conclusions	1 – Analyze data obtained in a scientific investigation to identify trends 5 – Explain how evidence supports the validity and reliability of a conclusion
		4 – Communication	1 – Communicate the results of an investigation 2 – Choose an appropriate graphic representation for collected data 3 – Present analyses and conclusions in clear, concise formats 5 – Communicate the results and conclusions of the investigation
	3	2 – Science and Technology in Society	1 – Propose viable methods of responding to an identified need or problem 2 – Compare solutions to best address an identified need or problem

Science Standards Continued

Grade	Strand	Concept	Performance Objective
High School	1	1 – Observations, Questions, and Hypotheses	1 – Evaluate scientific information for relevance to a given problem
		4 – Communication	1 – For a specific investigation, choose an appropriate method for communicating the results 2 – Produce graphs that communicate data 3 – Communicate results clearly and logically 4 – Support conclusions with logical scientific arguments
	3	1 – Changes in Environment	1 – Evaluate how the processes of natural ecosystems affect, and are affected by, humans 3 – Assess how human activities can affect the potential for hazards 4 – Evaluate how urban development affects the quality of the environment
		2 – Science and Technology in Society	2 – Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology 3 – Support a position on a science or technology issue 5 – Evaluate methods used to manage natural resources

Mathematics Standards

Grade	Strand	Concept	Performance Objective
7	2	1 – Data Analysis (Statistics)	3 – Determine when it is appropriate to use histograms, line graphs, double bar graphs, and stem-and-leaf plots 4 – Interpret data displays including histograms, stem-and-leaf plots, circle graphs, and double line graphs 5 – Answer questions based on data displays including histograms, stem-and-leaf plots, circle graphs, and double line graphs 7 – Interpret trends from displayed data 8 – Compare trends in data related to the same investigation 9 – Solve contextual problems using histograms, line graphs or continuous data, double bar graphs, and stem-and-leaf plots

Mathematics Standards Continued

Grade	Strand	Concept	Performance Objective
8	2	1 – Data Analysis (Statistics)	3 – Determine the appropriate type of graphical display for a given data set 7 – Formulate reasonable predictions based on a given set of data 8 – Compare trends in data related to the same investigation
High School	2	1 – Data Analysis (Statistics)	2 – Organize collected data into an appropriate graphical representation 8 – Make reasonable predictions for a set of data, based on patterns 9 – Draw inferences from charts, tables, graphs, plots, or data sets 11 – Evaluate the reasonableness of conclusions drawn from data analysis

Writing Standards

Grade	Strand	Concept	Performance Objective
7 – 8	2	1 – Ideas and Content	1 – Use clear, focused ideas and details to support the topic 3 – Develop a sufficient explanation or exploration of the topic 4 – Include ideas and details that show original perspective
		2 – Organization	3 – Place details appropriately to support the main idea 5 – Construct paragraphs by arranging sentences with an organizing principle (e.g., to develop a topic, to indicate a chronology)
		3 – Voice	2 – Convey a sense of identity through originality, sincerity, liveliness, or humor appropriate to the topic and type of writing 4 – Choose appropriate voice (e.g., formal, informal, academic discourse) for the audience and purpose
		4 – Word Choice	1 – Use accurate, specific, powerful words that effectively convey the intended message 3 – Use vocabulary that is original, varied, and natural
		5 – Sentence Fluency	2 – Create sentences that flow together and sound natural when read aloud

Writing Standards Continued

Grade	Strand	Concept	Performance Objective
7 – 8	3	2 – Expository	1 – Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic 3 – Write a process essay that includes: a. a thesis statement b. supporting details c. introductory, body, and concluding paragraphs
High School	2	1 – Ideas and Content	3 – Provide sufficient, relevant and carefully selected details for support 5 – Include ideas and details that show original perspective and insights
		2 – Organization	3 – Place details appropriately to support the main idea 5 – Employ a variety of paragraphing strategies (e.g., topical, chronological, spatial) appropriate to application and purpose
		3 – Voice	2 – Convey a sense of identity through originality, sincerity, liveliness, or humor appropriate to the topic and type of writing 3 – Choose appropriate voice (e.g., formal, informal, academic discourse) for the application
		4 – Word Choice	1 – Use accurate, specific, powerful words and phrases that effectively convey the intended message 2 – Use vocabulary that is original, varied, and natural 3 – Use words that evoke clear images
		5 – Sentence Fluency	3 – Demonstrate a flow that is natural and powerful when read aloud

Writing Standards Continued

Grade	Strand	Concept	Performance Objective
High School	3	2 – Expository	1 – Write a multi-paragraph essay that: a. includes background information to set up the thesis (hypothesis, essential question), as appropriate b. states a thesis with a narrow focus c. includes evidence in support of a thesis in the form of details, facts, examples, or reasons d. communicates information and ideas from primary and/or secondary sources accurately and coherently, as appropriate e. attributes sources of information as appropriate f. includes a topic sentence for each body paragraph g. includes relevant factors and variables that need to be considered h. Includes visual aids to organize and record information on charts, tables, maps, and graphs, as appropriate i. includes an effective conclusion

Appendix B: Worksheets and Overheads

The pages that follow contain the worksheets listed below:

A. *How Do We Stop Wildlife-Vehicle Collisions?* – A handout describing the activity (1 page)

B. *Ecology of Elk* – A brief summary of the history and ecology of elk in Arizona (1 page)

C. *Elk Movement Research* – A summary of the actual data collected on elk movement near State Route 260 (3 pages)

D. *Research Rubric* – One method to evaluate the student report (1 page)